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ABSTRACT

A study investigated the composing process to examine why different types of instruction have different effects on composing products. The study contrasted three treatments: (1) presenting students with models (the traditional method); (2) the general procedures approach stressing freethinking process; and (3) a method stressing task-specific procedures (a less published approach). Six typical students from each treatment contributed protocols for the study. The protocols were divided into two general segments: content and process. Content categories identified statements in which students generated the elements of a definition as taught in the instructional treatments. Students generated three main types of generalizations: criterion (rule that provides a contrast between members and non-members); attribute (attempted criterion that does not provide contrast; and incidental statements (statement about the topic). In addition to content statements, students indicated in their protocols various composing processes, including: Block (student expresses difficulty with definition task); Search (writers initiate a review of their knowledge); and Task Conception (writers refer to the assignment, instruction, or other factors that constrained or directed their writing. Results indicated that the one measurement by which all treatments improved was the support of criteria with contrasting examples, a skill essential to writing clear definitions. Students who showed the greatest improvement in all three areas were those who combined the study of models with Task Specific composing procedures. These students showed an understanding of definition construction by linking the elements of a definition purposefully. (Information accompanying 11 overheads is included.) (MG)

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The Effects of Different Types of Knowledge on the Writing Process

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Paper presented at the annual meeting of the Conference on College Composition and Communication, March 23, 1990, Chicago

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Composition textbooks tend to approach the teaching of writing through a few distinct methods.

MODELS

The traditional method has been to present students with models of particular writing forms, have students identify the structural features of the forms, and then require students to produce the forms. The models can be general, as in the notorious five paragraph essay, or specific, as in models of the so-called writing modes such as argument or definition. This approach assumes that practice in labeling the structural parts of a form - such as an introductory paragraph, or the supporting evidence in an argument - gives a writer procedures for producing that form.

GENERAL PROCEDURES

More recently, a "process" approach to writing has become popular, with texts breaking writing into three stages: prewriting, writing, and revision. Rather than focusing on <u>form</u>, this approach stresses <u>procedures</u>, with writers engaging in activities such as freewriting or brainstorming in order to discover what they have to say. These freethinking processes help writers sift through content knowledge and discover ways of transforming it to written text. Many authorities argue that these general procedures are effective strategies for generating content regardless of the task; presumably they would be equally effective for writing a personal narrative or a lab report or perhaps even a PhD dissertation. This approach is distinct from the Models approach in that the focus is on learning <u>procedures</u>

for rendering content knowledge into writing rather than learning to label the features of a form written by someone else. Some recent textbooks have attempted to include both of these approaches, often in separate sections of the text and entirely unrelated to one another.

TASK-SPECIFIC PROCEDURES

A third approach, far less frequently published in texts, has writers focus again on procedures for transforming content knowledge, but stressing task-specific procedures rather than general procedures such as freewriting. By task-specific procedures I mean procedures which are helpful in certain tasks but not necessarily in others. For instance, writing that involves definition - examples would include biological classification, literary criticism, or delineating any kind of rule or law - requires knowledge of procedures for generating three elements: criteria to establish what belongs and what does not belong in the class being defined; examples that illustrate each criterion; and contrasting examples that appear to illustrate a criterion but lack some essential characteristic. One procedure for generating these elements is for students to examine a set of problematic examples, and generate criteria from their analysis. For example, students generating a definition of freedom of speech might study the example of someone shouting "fire" in a crowded theater in order to develop a criterion. This approach, then, is distinct from learning general procedures in that it involves learning task-specific procedures that might not facilitate writing in other situations.

TURN OFF OVERHEAD

This intra-discipline dispute over the relative effectiveness of different types of knowledge in improving writing is part of a broader debate in cognitive theory. Scholars have contested the relative effectiveness of general procedures and task-specific procedures in general learning for decades. Ernst and Newell (1969) have investigated the general applicability of certain heuristics such as the "General Problem Solver" and found them effective procedures for solving new problems under different circumstances. Others have questioned the transferability of general procedures. Glaser studied the problem-solving processes of experts and found that they had a knowledge of domain-specific patterns and an ability to recognize and apply their knowledge of these patterns to solve novel problems. Pressley, Snyder and Cariglia-Bull (1987) found that effective thinking depends on specific, context-bound skills and knowledge that have little application to other domains; they find little empirical support for the idea that we can teach transferable, generalizable, context-independent skills and strategies. Some researchers have tried to reconcile the opposing theories by suggesting that a balance of general and task-specific procedures is most beneficial (Perkins and Salomon, 1989) or by investigating conditions in which general procedures are amenable to transfer (Nickerson, Perkins and Smith, 1985).

The use of models, too, has had its defenders, even though they have been disdained by many composition experts. Research in observational learning - that is, studying models in such

varied areas as dance, psychotherapy sessions and problem solving - has shown that the observation of certain acts may result in better performance than simply attempting to perform such acts; Little Leaguers learning to bunt could benefit more from watching an expert model bunting techniques than if they were simply to engage in "discovery bunting."

We have, therefore, a problem not confined to the field of composition but representing a dispute over the types of knowledge that affect learning in general. My dissertation used protocol analysis to contrast the effects of instruction in models, general procedures and task-specific procedures on the composing process of students writing essays involving definition, a task with distinct features. The aggregate of studies contrasting the types of knowledge studied here has suggested that task-specific procedural knowledge taught through the study of a data set such as a series of problematic examples is more effective in improving writing than general procedures (such as freewriting) or the study of models. What causes these differences? How do students <u>think</u> as a result of different instructional foci? How do different types of knowledge affect composing differently? The purpose of this study is to investigate <u>composing process</u> to examine <u>why</u> different types of instruction have different effects on composing products.

Design

OVERHEAD #1 BACK ON

The study contrasted three treatments: <u>Models</u>, <u>General Procedures</u>, and <u>Task-Specific Procedures</u>. All three treatments

included study in model essays with about 40% of the instruction uniform in all treatments. The purpose of this common instruction was to examine the effects of manipulations in different treatments following instruction in a common source of knowledge. Following the identical introductory sequence, the treatments varied as follows:

Students in the Models treatment studied, labeled and evaluated additional models of definition essays. They were not taught procedures for generating the elements of a definition (criteria, examples and contrasting examples).

Students in the General Procedures treatment were taught the procedures of freewriting and brainstorming to generate criteria, examples and contrasting examples, plus strategies for revision.

Students in the Task-Specific Procedures treatment were taught the procedure of studying problematic examples to generate criteria, examples and contrasting examples, plus strategies for revision.

Six typical students from each treatment contributed protocols for the study. A separate study examined product effects for all students in the study.

Protocol Analysis

I first divided the protocols into "segments." A segment is a section of text that states a single idea (such as a single criterion, attribute, example, etc.).

SHOW OVERHEAD #2

Coding categories fell into two general areas: content and process.

Content

Content categories identified statements in which students generated the elements of a definition as taught in the instructional treatments. Students generated three main types of generalizations:

1.A criterion is a generalization that clearly provides a contrast between a member belonging to the class being defined and one that does not belong. For example, a writer might say, "True friends do things together after school, whereas acquaintances might be friends in class but never do anything together outside school."

2.An attribute is an attempted criterion that does not provide a contrast. For instance, rather than providing the contrast that acquaintances do not do things outside school, an attribute might merely state that "Friends do things together."

3.Incidental statements are usually true, and concern the topic, but do not define it. Such a statement would be, "Without leaders, the world would be in chaos." While true, this statement does not help define the term.

Students supported generalizations with two types of examples:

1.An example described some behavior that illustrated the generalization; for instance, to support the criterion of friends doing things together a student might say, "For instance, Tom and

Bill are friends because they hang around together in school and also go to parties together on weekends, often double dating."

2.A contrasting example described behavior that seemed to illustrate the generalization but lacked some essential characteristic; often this contrast came through a manipulation of the original example. A contrasting example for the criterion distinguishing friends from acquaintances might be, "Tom and Ted, however, are only acquaintances. Although they eat lunch together and are both on the football team, once they leave school they never call each other or hang around together."

Process

In addition to content statements, students indicated in their protocols various composing processes. Three processes emerged as significant in the protocol analysis:

1.In a statement indicating Block, writers stated an inability to generate ideas, saying such things as, "Let me see, I'm stuck right here. I can't get into this."

2.In statements indicating a Search, writers initiated a review of their knowledge to get ideas for further composing, saying something like, "OK, that's a criterion, now I need some examples," or "I'm going to think of times in my own life when I knew people weren't my friends and tried to pretend they were."

3.Writers also referred to their Conception of the Task when they would refer to the assignment, the instruction or other factors that constrained or directed their writing. Such a statement might include rereading the essay instructions or saying, "I think it's OK to use personal examples."

Overhead #2

CODING CATEGORIES

CONTENT

Generalization

Criterion: Rule that provides a contrast between members and non-members.

Attribute: Attempted criterion that does not provide contrast

Incidental statement: Statement about the topic, does not define

Support

Example: Illustrates the generalization

Contrasting Example: Behavior that seems to illustrate a generalization, but lacks essential characteristic

PROCESS

Block: Student expresses difficulty with definition task

Search: Initiates review of writer's knowledge

Task Conception: Reference to assignment, instruction, or other constraint

Following segmenting and coding I analyzed the data by isolating each category and tracking it through each of the 36 protocols to identify patterns in students' thinking, looking in particular for patterns of interaction between and among categories.

Results

The protocols revealed differences among treatments in three main areas which I call purposeful composing, critical thinking and strategic thinking.

Purposeful Composing

By purposeful composing I mean the extent to which students related generalizations to support. In the pretests, students in all treatments tended to generate generalizations without supporting them with examples and contrasting examples. Rather, they would generate a criterion here, an example there, without relating them to one another. The students appeared simply to be generating ideas about the topic without integrating them purposefully. In the posttest protocols, students were more likely to relate generalizations to support and thus compose purposefully.

SHOW OVERHEAD #3

Here is an example of a student whose writing illustrates purposeful composing. Each segment is initially identified by its category; underlined categories indicate segments written in the essay.

Overhead #3

PURPOSEFUL COMPOSING

1. Criterion #1: True friendship is helping someone else out, not taking advantage of them.
2. Elaborate Criterion #1: True friendship is -
3. Peripheral: (referring to writing and talking at the same time) This is hard.
4. Elaborate Criterion #1: helping someone you know out - helping someone out without any benefit to yourself.
5. Search: Let's see, the first criteria -
6. Task Conception: True friendship.
7. Criterion #2: In order to be a true friend, you must be loyal to your friend.
8. Elaborate Criterion #2: Someone who goes around their supposed - supposedly friend's back - let's see - someone who goes around their supposedly friend's back and talks about them saying things which demean their friend is not a friend.
9. Determination: Let's see, that's criteria number one.
10. Task conception: (rereads instructions)
11. Search: Let's see, there aren't too many of them.
12. Determination: I'll just go on.
13. Elaborate Criterion #1: If you gain a benefit from your friendship, then that gain must not have been intentional.
14. Example #1: Let's see now. Two kids are friends, or have been friends for life, when they grow up one becomes rich then dies suddenly.
15. Elaborate Example #1: He leaves everything to his lifelong friend.
16. Elaborate Example #1: The friend had no idea the other friend would get rich.
17. Warrant #1: He benefitted from his friendship but did not become friends with the person just for the money.
18. Form - Micro: I should use names, fake names.
19. Block: I'm getting so confused.
20. Contrasting Example #1: On the other hand, Jack knows about Joe who is a billionaire and is dying.
21. Elaborate Contrasting Example #1: Jack gets some friends of his to introduce him to Joe.
22. Elaborate Contrasting Example #1: Jack then proceeds to help Joe out in any way he can.
23. Elaborate Contrasting Example #1: In doing so Jack is included in Joe's will.
24. Warrant #2: Jack became friends with Joe just to exploit Joe.

This student, whom I'll call Fred, stated and elaborated his criterion (segments 1, 2, 4, 13), providing the important distinction in segment 13 that friends must not intentionally benefit from each other. He then provided an example that illustrated the criterion (segments 13-15) and used a warrant (segment 17) to tie the example to the criterion. Finally, Fred manipulated his example (segments 19-22) so that it provided a contrast, illustrating a behavior that seemed to satisfy the criterion but lacked the essential characteristic of not intentionally benefitting from the relationship (segment 13). He made this connection explicit with his final warrant (segment 24). This use of criterion, example and contrasting example illustrated purposeful composing in that the writer used his criterion and support in relation to one another.

I measured purposeful composing in four areas:

1. Support of a criterion with both an example and a contrasting example.
2. Support of a criterion with just an example.
3. Support of a criterion with just a contrasting example.
4. Support of an attribute or incidental statement with an example.

SHOW OVERHEAD #4

1.Support of a criterion with both example and contrasting example

The overhead shows how students improved from pretest to posttest in the support of a criterion with both an example and a contrasting example in the manner of Fred's protocol from the previous overhead. The improvement score is simply the score that results from subtracting the pretest from the posttest. The rate of change is determined by subtracting the pretest score from the posttest score and then dividing the result by the pretest score.

Students who learned task-specific procedures improved a great deal in this measurement; were it not for the zero in the pretest that prevented a rate of change calculation, they would have had an enormous rate of change. One deceptive aspect of these results - and an illustration of the dangers of generalizing from a small sample - is that one student in the Models treatment improved from zero to four in this measurement. Without his anomalous performance, students in this treatment declined slightly.

Overhead #4

PURPOSEFUL COMPOSING

1.SUPPORT OF A CRITERION WITH BOTH EXAMPLE AND CONTRASTING EXAMPLE

Treatment	Pre test	Post test	Improvement score	Rate of change
Models	5	8	3	60%
General	3	4	1	33%
Task-Sp.	0	6	6	

Improvement Score: Posttest minus protest

Rate of Change: Posttest minus Pretest/Pretest

SHOW OVERHEAD #5

2.Criterion supported with just an example

Another area of improvement was when students supported a criterion just with an example. While not as strong an indication of support as using both an example and a contrasting example, it still represented an improvement over unsupported criteria. I made this calculation by examining the change in the ratio of unsupported to supported criteria. For this table, the rate of change was calculated in the same way as in the previous table. As you can see, the Models treatment and the Task Specific procedures treatment both had a strong and roughly equal effect, with the General procedures treatment having a negative effect in the total number generated and a slightly beneficial effect in the number of instances written in the essays.

For improvement scores involving ratios such as this one, I made the calculation based on the way in which I would predict improvement. Using the Models score as an example, I would expect students to reduce the number of unsupported criteria - represented in the numerator - and so subtracted the posttest numerator from the pretest numberator. I would expect students to increase the number of supported examples - represented in the denominator - and so subtracted the pretest denominator from the posttest denominator. The sum of these two scores made up the improvement scores. As you can see, the improvement scores corroborated the results from the rate of change scores, strengthening the findings on this effect.

Overhead #5

PURPOSEFUL COMPOSING

2.RATIO: CRITERIA UNSUPPORTED BY EXAMPLES/CRITERIA SUPPORTED BY EXAMPLES

Treatment	Pre test	Post test	Rate of change	Impr. Score
Total				
Models	10/8	4/10	68%	8
General	13/11	10/8	-6%	0
Task Sp.	8/4	4/7	72%	7
Written				
Models	10/8	4/10	68%	8
General	13/9	10/8	13%	2
Task Sp.	7/3	4/7	76%	7

Rate of Change: Posttest ratio minus pretest ratio/pretest ratio

(4/10 - 10/8) / (4/10) = .68

Improvement Score: (Pretest numerator minus Posttest numerator) plus (posttest denominator minus pretest denominator)

(10-4) + (10-8) = 8

SHOW OVERHEAD #6

3.Criterion supported by just a contrasting example

This table shows the results from the support of a criterion with just a contrasting example. Students in all three treatments made good gains in this measurement, as indicated by both the rate of change scores and the improvement scores.

Overhead #6

PURPOSEFUL COMPOSING

3.RATIO: CRITERIA UNSUPPORTED BY CONTRASTING EXAMPLES/ CRITERIA SUPPORTED BY CONTRASTING EXAMPLES

Treatment	Pre test	Post test	Rate of Change	Impr. Score
Total				
Models	12/6	5/9	72%	10
General	20/4	12/6	60%	10
Task Sp.	10/2	4/7	89%	11
Written				
Models	12/6	5/9	72%	10
General	18/4	12/6	60%	8
Task Sp.	8/2	4/7	86%	9

SHOW OVERHEAD #7

4.Support of an attribute or incidental statement by an example

The final measurement of purposeful composing came from the support of a weak generalization - an attribute or an incidental statement - with an example. I counted these because they were attempts at supporting criteria, and therefore represented the same process. The only clear result from this measurement is that the Task-Specific procedures treatment had a strong effect. The Models treatment had a strongly negative effect on the total number of instances in the protocols, but negligible effect on the number written in the essays; while the General procedures treatment had an erratic effect. When I ran an Analysis of Variance on the improvement scores, I found significant differences between the Task Specific procedures and Models treatments for the total number of instances in the protocols.

Overhead #7

PURPOSEFUL COMPOSING

4.RATIO: UNSUPPORTED ATTRIBUTES + INCIDENTAL STATEMENTS/
SUPPORTED ATTRIBUTES + INCIDENTAL STATEMENTS

Treatment	Pre test	Post test	Rate of change	Impr. Score
Total				
Models	33/13	39/9	-70%	-8
General	78/18	31/10	28%	39
Task Sp.	57/14	15/9	59%	37
Written				
Models	32/10	30/9	-4%	-1
General	49/10	21/4	-7%	22
Task Sp.	46/10	8/6	71%	34

Critical Thinking

SHOW OVERHEAD #8

The second area of effects I found came in what I call critical thinking. By critical thinking I mean students' ability to discriminate between generalizations that did and did not provide clear distinctions. Students who improved their ability to think critically about the definition task increased their ratio of strong generalizations - that is, criteria - to weak generalizations - attributes and incidental statements.

The table on the overhead shows the differences among treatments in improving this ratio. As you can see, both the General and Task Specific Procedures treatments had strong effects on students' critical thinking, with the Models treatment having a somewhat negative effect. An Analysis of Variance on the improvement scores showed both the General Procedures and Task Specific Procedures treatments significantly different from the Models treatment in this measurement for both the Total and Written instances.

Overhead #8

CRITICAL THINKING

RATIO OF ATTRIBUTES + INCIDENTAL STATEMENTS TO CRITERIA

Treatment	Pre test	Post test	Rate of Change	Impr. Score
Total				
Models	51/19	47/14	-25%	-1
General	100/24	31/18	59%	46
Task Sp.	74/12	24/12	67%	48
Written				
Models	44/19	39/14	-20%	0
General	64/18	28/16	51%	34
Task Sp.	59/10	17/11	74%	43

Strategic Thinking

SHOW OVERHEAD #9

The third area of effects I found came in what I call strategic thinking. By strategic thinking I mean the use of a procedure for generating or accessing ideas appropriate to the composing situation. Students demonstrated strategic thinking by conducting memory searches for relevant information at critical junctures of composing. Typical junctures include:

1.When a student attempted to initiate an episode of generalization and support. For instance, at the beginning of a paper, students would often start by asking themselves questions such as, "What kinds of things does a leader do?" Or following the successful generation of generalization and support, a student might say, "OK, now I need another criterion."

2.A second juncture came During the generation of criteria and support. For instance, after generating a criterion, a student would anticipate the next composing need by saying something like, "OK, what are some examples of people who are leaders because people respect them?"

3.A third juncture came Following a statement indicating blocked thought. For instance, a student might say, "I'm really stuck here. I can't think of anything right now. Who do I know that's a leader? What makes them leaders?"

4.A fourth juncture came Following a statement referring to the student's conception of the task. For instance, a student might say, "Let's see, I'm supposed to give examples. Who are some

famous leaders?"

The use of a search at these junctures to retrieve appropriate information suggested the presence of an internalized conversational partner as described in the well-known Bereiter and Scardamalia article from 1982, and thus procedural or strategic knowledge.

The rate of change and improvement scores are tabulated at the bottom of the column for each treatment. Students in the Models treatment made surprisingly good gains in this measurement. Students in the General Procedures treatment declined slightly. Students in the Task Specific Procedures treatment made strong gains.

Overhead #9

STRATEGIC THINKING

SEARCH

	Models	General	Task Sp.
1.Begin Episode			
Pretest	8	10	12
Posttest	6	5	16
2.Criteria/Support			
Pretest	1	0	0
Posttest	12	0	24
3.Block			
Pretest	0	0	1
Posttest	2	1	5
4.Task Conception			
Pretest	3	0	3
Posttest	1	3	6
Total			
Pretest	12	10	16
Posttest	21	9	51
Rate of Change	75%	-10%	219%
Improvement Score	9	-1	38

Overhead #10

TREATMENT EFFECTS

MODELS

Purposeful Composing

a.Criteria to ex. and contr. ex.: Questionable improvement
b.Criteria to ex.: Strong improvement
c.Criteria to contr. ex.: Strong improvement
d.Attribute/Incidental Statement to ex.: Negative effect

Critical Thinking

Negative effect

Strategic Thinking

Improvement

GENERAL PROCEDURES

Purposeful Composing

a.Criteria to ex. and contr. ex.: Marginal improvement
b.Criteria to ex.: Marginal improvement
c.Criteria to contr. ex.: Strong improvement
d.Attribute/Incidental Statement to ex.: Moderate improvement

Critical Thinking

Strong improvement

Strategic Thinking

Slightly negative effect

TASK-SPECIFIC PROCEDURES

Purposeful Composing

a.Criteria to ex. and contr. ex.: Consistent improvement
b.Criteria to ex.: Strong improvement
c.Criteria to contr. ex.: Strong improvement
d.Attribute/Incidental Statement to ex.: Strong improvement

Critical Thinking

Strong improvement

Strategic Thinking

Strong improvement

SHOW OVERHEAD #10

Discussion

The one measurement by which all treatments improved was the support of criteria with contrasting examples, a skill essential to writing clear definitions. We could perhaps attribute this common gain to instruction in the discourse knowledge taught in the Models treatment, since that all treatments included the study of models. The variations in the treatments produced different results in other areas, however. Students who studied only models lacked procedures for discriminating between strong and weak generalizations, a skill that the data suggested the other two treatments effectively taught.

The data suggest that models can improve some aspects of composing. Students focusing solely on the study of model essays made good gains in their ability to anticipate their content needs through strategic thinking, even though they showed erratic improvement in using this anticipation to produce appropriate content. The study of models does not, however, give writers procedures for determining the precision of their content ideas, as suggested by the inability of students from the Models treatment to improve their ratio of strong to weak generalizations. Through the study of models, therefore, students can learn the slots in a form but can not learn to evaluate the quality or appropriateness of the ideas they put in the slots.

Students learning general procedures for composing were able to think critically about the task. They had, however, mixed success in purposefully linking the elements of definition for effective composing as illustrated by their inability to support generalizations consistently with appropriate evidence. Furthermore, students from this treatment showed no improvement in establishing a conversational voice to guide composing needs, perhaps causing the mixed success in purposeful composing: Without the ability to anticipate content needs - for example, anticipating that a criterion should be supported by an example - students did not consistently produce the elements in relation to one another. Knowledge of general procedures, therefore, appears only moderately effective in providing procedures for integrating ideas according to particular task constraints.

The students who showed the greatest improvement in all three areas were those who combined the study of models with Task-Specific composing procedures. These students showed an understanding of definition construction by linking the elements of a definition purposefully. In thinking through the process of definition, they would often use strategic thinking to anticipate the relationship of elements and produce them according to task constraints.

SHOW OVERHEAD #11

The protocol of Sonya illustrates this process. Prior to generating the portion of the protocol shown on the overhead, she has made two attempts at generating a criterion but judiciously abandoned both since neither provides a contrast: "Leadership is leading a group and helping the group through situations"; and "Leadership is someone in a group who is more realistic and more confident." After discarding these attributes she generates a criterion and begins to support it, as we see on the overhead:

Overhead #11: Sonya

Criterion: Leadership is a person in a group who - a person in a group who, who everyone extends - everyone listens and pays attention to.

Example: For example - okay, for example a leader in a gang would be considered leadership.

Elaborate Example: He tells the people of his group what to do and then - wait - he tells the people of his group what to do and they react to his - and they do what he tells them.

Warrant: They listen to he or she.

Search: Okay, now I have to think of a contrasting example.

Reread: They listen to him and they do what he tells them.

Contrasting Example: Leadership would not be if some people picked a person who was not - wasn't confident in themselves and the person - and the person - told the people he or she do what they please.

Warrant: That would not - wouldn't be considered leadership because - hum - because people would not pay attention like that in the first place because the person has to be confident - well at least sound confident and not be scared.

Sonya's protocol illustrates how strategic thinking can promote purposeful composing. At a critical juncture of composing - after supporting a criterion with an example - she begins a search for the next appropriate content need, a contrasting example. Her strategic thinking thus enables her to compose purposefully.

Her protocol also illustrates her ability to think critically in that she rejects two attributes before generating and accepting a criterion. Students who learned the task-specific procedure of generating criteria from problematic examples were more likely to engage in this sort of process: to learn the relationships among elements - i.e., to learn the slots in the model - and anticipate relevant content needs through the explicit use of a search; and to think critically about ideas they put in the slots. Students in the other two treatments improved in some of these areas, but did not make consistent gains in these critically related areas.